INSTRUCTION MANUAL

SYNCHRO ISOLATION
AMPLIFIER
SERIES 4540

SCIENTIFIC-ATLANTA, INC.

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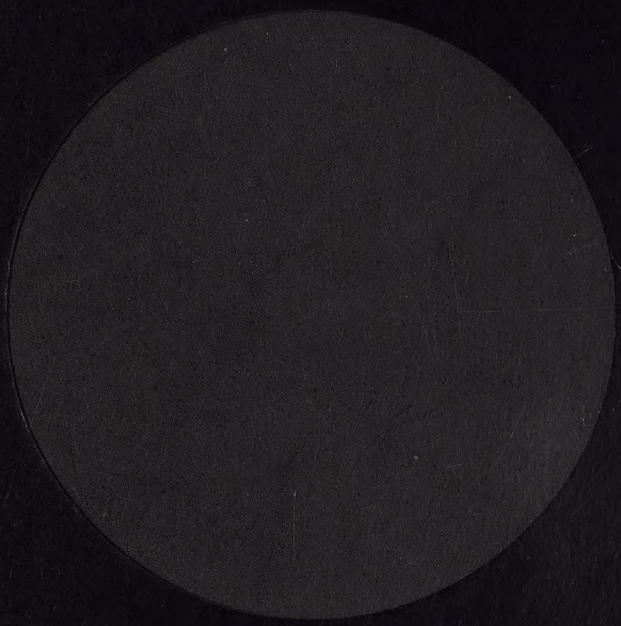
manual # 1



When ordering parts from Scientific-Atlanta, Inc., be sure to include the equipment model number, equipment serial number, and a description of the part.

MODEL NO._____

SERIAL NO._____

INSTRUCTION MANUAL

CAUTION
Refer to Chapter 2 before applying power to this unit

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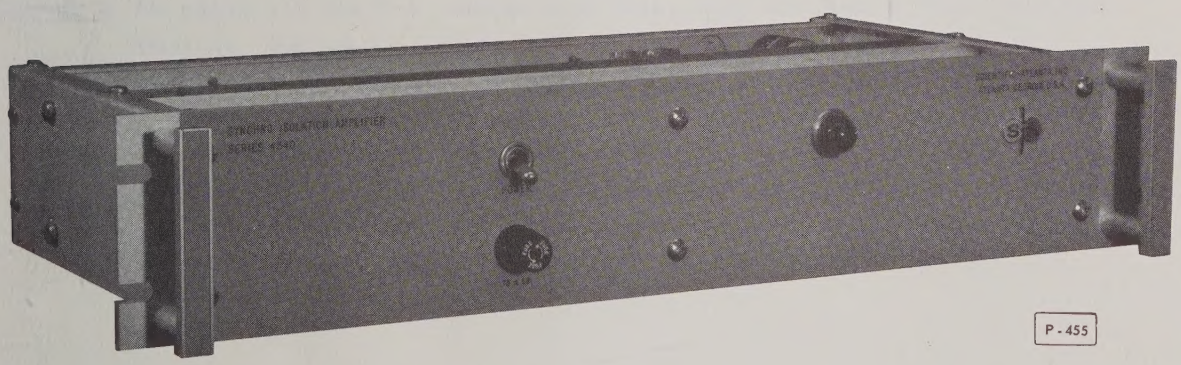

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Fourth Edition
February 1965

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INSTRUCTION MANUAL
CHANGE NOTICE

SERIES 4540, FOURTH EDITION, FEBRUARY 1965

To make this manual apply to your instrument, make the manual changes shown below.

Instrument Serial No.	Change
All	Errata
All	1
193 and up	2
217 and up	3

Instrument Serial No.	Change

Errata: Resistors R31 and R32 should be shown as "10K, 2w" on the schematic diagram.

Change 1: The Model 4542 Synchro Isolation Amplifier is now designated as "Model 4541-P." Therefore, any reference in this manual to "Model 4542" should be changed to "Model 4541P."

The Model 4541-5 Synchro Isolation Amplifier, a modified Model 4541, will drive size-5 synchros. A series circuit consisting of a 25-ohm, 12.5w potentiometer and a 10-ohm, 5w resistor is added in series from pin A of J2 to pin A of J3. Adjust the potentiometer for maximum voltage across capacitor C7. Jumper the potentiometer and resistor when operating with size-23 synchros.

Change 2: On page 5-4, change power transformer T5 to "Florida Transformer Co. Part No. TP 01381."

Change 3: On pages 5-4 and 5-5, change R35, R36, R39, and R40 to "5w; Tru-Ohm Part No. VAL-5."

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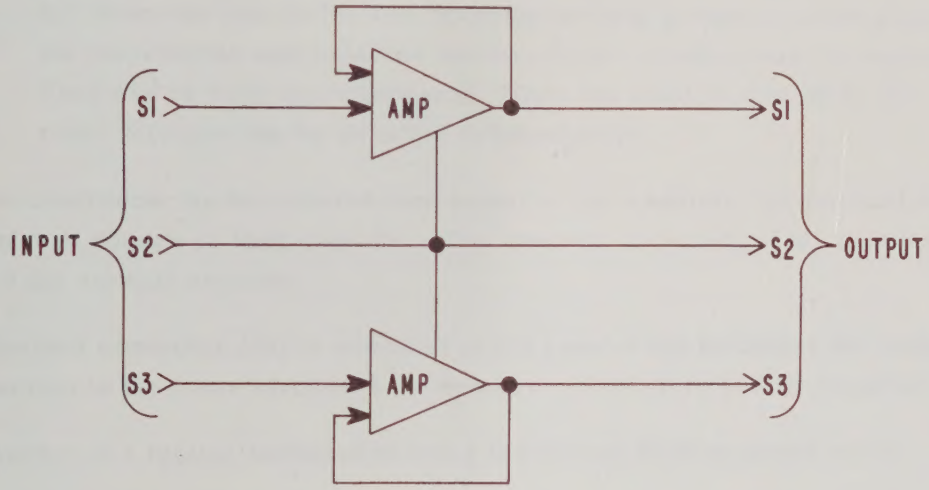
CHAPTER 1

GENERAL INFORMATION

1.1 Introduction

The Scientific-Atlanta Series 4540 Synchro Isolation Amplifier is a compact, transistor amplifier. It is used to drive multiple size 23 synchro indicators from a single size 23 torque transmitter without producing errors by transmitter loading.

The amplifier has two identical channels; each consists of a high-gain, transistor power amplifier. Inverse feedback in each channel provides unity closed-loop gain and high effective input impedance.



1.2 Specifications

Accuracy	±1° from 1:1 synchro ±0.03° from 36:1 synchro
Maximum Number of Synchros Driven	6 - size 23 receivers
Input Signal	From stator leads of 115/90v, 60-cycle, size 23 synchro transmitter
Input Impedance	10,000 ohms
Output Impedance	Less than 10 ohms
Power Requirements	115v, 60 cps, 1φ*, 45 watts

* Rotors of transmitting synchro and repeaters must be supplied with voltage of the same phase.

Dimensions	Standard 19-inch panel, 3-1/2 inches high; chassis is 10-3/4 inches deep overall
Weight	
Net	15 pounds
Shipping	25 pounds

CHAPTER 2

INSTALLATION

The synchro isolation amplifier can be installed in any convenient location. Adequate ventilation should be provided during operation. Output and input connections are made through Type MS connectors located at the rear of the unit.

2.1 Source and Load Connections*

The source and load circuits should satisfy the following conditions to prevent line-fuse blowing by overload power demands.

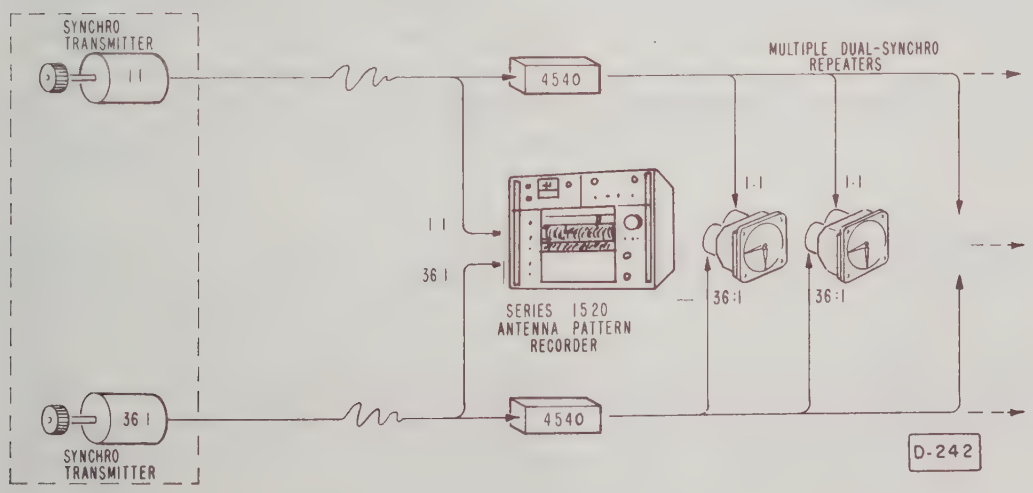
(a) The transmitter synchro must be connected to the amplifier before application of ac power to the unit.

(b) When the unit is ON and is connected to a torque receiver load, the transmitter and receiver synchro rotor voltages must be equal; They can be both-on or both-off. When the amplifier is OFF, the rotor voltages can be switched independently.

These conditions can be violated momentarily, for example, in external switch-transfer of source or load circuits. The fuse will blow only if the overload is sustained for several seconds.

An unwired connector (J4) is provided at the rear of the amplifier for making external connection to the rotor circuit of the synchro transmitter and/or receiver.

A diagram of a typical installation using the Series 4540 is shown below.



* See also paragraph 2.2.

Each amplifier is wired at the factory for operation from the 1:1 synchro of a standard Scientific-Atlanta Synchro Transmitter Unit. Isolation of the 1:1 synchros is accomplished by wiring the input and output cables in such a way that S1 is tied to pin D and S3 to pin E (see schematic diagram) at both input and output connectors. Isolation of the 36:1 synchros is accomplished by wiring the input and output cables such that the S1 and S3 signals of the 36:1 synchros are tied to pins D and E respectively.

Because the ac voltage for the synchro transmitter rotors are wired straight through the amplifier (pins A and C of J2 and J3), each installation will require investigation of the source of the synchro rotor voltage. As an example, the Series 1520 or 1530 Recorder and the Series 4400 Position Indicators may furnish ac voltage to the synchro transmitter package. When either a recorder or a position indicator is used with the synchro transmitter package, no problem arises. However, when a recorder, a position indicator, and a synchro transmitter package are used simultaneously, the recorder should be cabled directly to the synchro transmitter with the ac rotor from the recorder omitted in the cabling. The ac rotor voltage is thus furnished by the position indicator through the synchro isolation amplifier.

2.2 Feedback Adjustment (Model 4542 Only)

To permit size 23 CDX'S to be used as a source, a feedback potentiometer is provided on Model 4542 Synchro Isolation Amplifiers. Before applying power to the amplifier, turn the feedback potentiometer (R30) fully counterclockwise. This potentiometer is located on the rear chassis apron.

Connect the source and load (paragraph 2.1) and apply power.

Connect a dc voltmeter across capacitor C7 (the large electrolytic at the right front of the unit). Adjust R30 for a maximum meter reading. This indicates minimum amplifier loading.

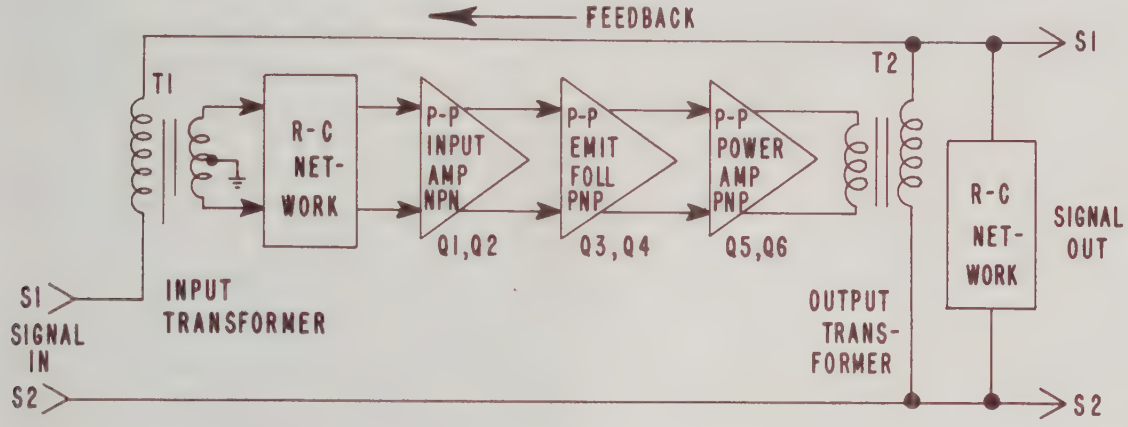
Readjust R30 after each source and/or load change.

CHAPTER 3

DETAILED DESCRIPTION

3.1 Amplifier

A schematic diagram is located at the rear of this manual. Because each channel is identical, only the upper channel is described. Each amplifier consists of three push-pull, class B stages as shown below.



The input signal to the upper channel is the transmitter S1-S2 stator voltage. Synchro indicators connected directly across output transformer T2 constitute an "active" load. Therefore, because of the feedback connection, only a very small "error" signal (the difference between instantaneous input and output voltages), appearing across the primary of input transformer T1, is required to drive the amplifier to full output. Maximum amplifier output power is required under dynamic conditions, when the indicators must be driven to angular correspondence with the input synchro transmitter; however, the static power requirements of the amplifier are small. The impedance magnification provided by the feedback connection results in a very high effective input impedance.

An R-C network in the secondary circuits of the input and output transformers provides equalization of the open-loop phase-amplitude characteristics to ensure closed-loop stability.

In the Model 4542, a dual potentiometer (R30)--one section of which is across each output transformer secondary--is used to vary the feedback to the input. This permits the loading on an input CDX to be minimized.

Diodes CR1 and CR2 at the base of each input transistor, Q1 and Q2, clip the negative excursions of the input waveform to limit the reverse-bias voltage applied to the base-emitter junctions.

3.2 Power Supply

The power supply is a full-wave rectifier that consists of transformer T5, diodes CR5 and CR6, and filter capacitor C7.

CHAPTER 4

MAINTENANCE

Standard troubleshooting techniques may be employed in each channel of the amplifier. The following table lists nominal voltage values to be expected; tolerances of ±20% may be encountered from unit to unit.

All voltages are measured between the points indicated with a 20,000 ohms-per-volt dc meter unless otherwise indicated. The input signal is as specified in Table 4.2. The output load for voltage measurement purposes should consist of one size 23 synchro receiver. Maintain line voltage at 117 volts.

Table 4.1. DC Voltages

FROM	TO	VOLTAGE
C7 (B+)	GND	+17.5
Q1, Q2, Q7, Q8, base	GND	+ 0.4
Q1, Q2, Q7, Q8, collector	C7 (B+)	- 0.2
Q3, Q4, Q9, Q10, emitter	C7 (B+)	- 0.1
Q3, Q4, Q9, Q10, base	C7 (B+)	- 0.2
Q5, Q6, Q11, Q12, base	C7 (B+)	- 0.1
Q5, Q6, Q11, Q12, collector	GND	less than +0.1

Table 4.2. Signal Voltages
(5000 ohms-per-volt meter)

Pri of T1 or T3	0.1 v rms
Pri of T2 or T4	11 v rms

CHAPTER 5

REPLACEMENT PARTS LIST

MANUFACTURERS' CODE LETTERS

Code	Manufacturer
A	Aerovox
ABE	Amphenol-Borg
BC	Barber-Coleman
BUS	Bussman
CD	Cornell-Dubilier
CH	Cutler-Hammer
CM	Cinch
DI	Dialight
DRD	Delco
GE	General Electric
L	Littelfuse
M	Miller
O	Ohmite (LD = "Little Devil")
PB	Potter & Brumfield
RCA	Radio Corporation
RE	Royal Electric
SY	Sylvania Electric
TI	Texas Instruments
TT	Triad
XX	Any brand diode or transistor which meets JEDEC standards

PARTS LIST

SERIES 4540 SYNCHRO ISOLATION AMPLIFIER

Component Designation	Description	Mfr.*	Mfr. Part No.
B1	Fan, ventilation, 115v ac, 60 cps	BC	DYAB-11291
	Fan blade	BC	YAB-355-2
C1 C2 C4 C5	Capacitor, fixed, metallized paper, 0.1 µf, 200v	A	P8292ZN
C3 C6	Capacitor, fixed, oil filled, 1 µf, 600v	CD	WAT6100
C4 C5	See C1		
C7	Capacitor, fixed, electrolytic, 4500 µf, 75v	M	CG452U50D1
C8A/B	Capacitor, fixed, bathtub, 0.25-0.25 µf, 600v	A	JP30M
C9	Capacitor, fixed, bathtub, 0.25 µf, 600v	A	JP30M
CR1 thru CR4	Diode, germanium	XX	1N277
CR5 CR6	Diode, silicon	XX	1N3208R
CR7 CR8	Diode, Zener	TI	1N1816C
DS1	Lamp, neon glow	GE	NE-51
F1	Fuse, 0.75a, 3AG, slow blow	L	3130.75
J1	Unassigned		
J2	Connector, receptacle, female, 8 contacts	ABE	MS3102A-20-7S
J3	Connector, receptacle, male, 8 pins	ABE	MS3102A-20-7P
J4	Connector, receptacle, male, 2 pins	ABE	MS3102A-12S-3P
K1	Relay, DPDT, 115v ac coil	PB	KRP11AG
P1	Plug and cordset, ac power	RE	K5146
P2	Connector, cable, male, 8 pins	ABE	MS3106A-20-7P
P3	Connector, cable, female, 8 contacts	ABE	MS3102A-20-7S
P4	Connector, cable, female, 2 contacts	ABE	MS3106A-12S-3S
Q1 Q2 Q7 Q8	Transistor	RCA	2N2270

*See "MANUFACTURERS' CODE LETTERS."

PARTS LIST

SERIES 4540 SYNCHRO ISOLATION AMPLIFIER - continued

Component Designation	Description	Mfr.*	Mfr. Part No.
Q3 Q4 Q9 Q10	Transistor	SY	2N242
Q5 Q6 Q11 Q12	Transistor	DRD	2N441
Q7 Q8	See Q1		
Q9 Q10	See Q3		
Q11 Q12	See Q5		
R1 R4 R7 R8 R14 R17 R20 R21	Resistor, fixed, composition, 12,000 ohms ±10%, 1/2w	O	LD
R2 R3 R9 R10 R15 R16 R22 R23	Resistor, fixed, composition, 470 ohms ±10%, 1/2w	O	LD
R4	See R1		
R5 R6 R18 R19	Resistor, fixed, composition, 270,000 ohms ±10%, 1/2w	O	LD
R7 R8	See R1		
R9 R10	See R2		
R11 R12 R24 R25	Resistor, fixed, composition, 15 ohms ±10%, 1w	O	LD
R13 R26	Resistor, fixed, composition, 100 ohms ±10%, 1w	O	LD
R14	See R1		
R15 R16	See R2		
R17	See R1		
R18 R19	See R5		
R20 R21	See R1		
R22 R23	See R2		

*See "MANUFACTURERS' CODE LETTERS."

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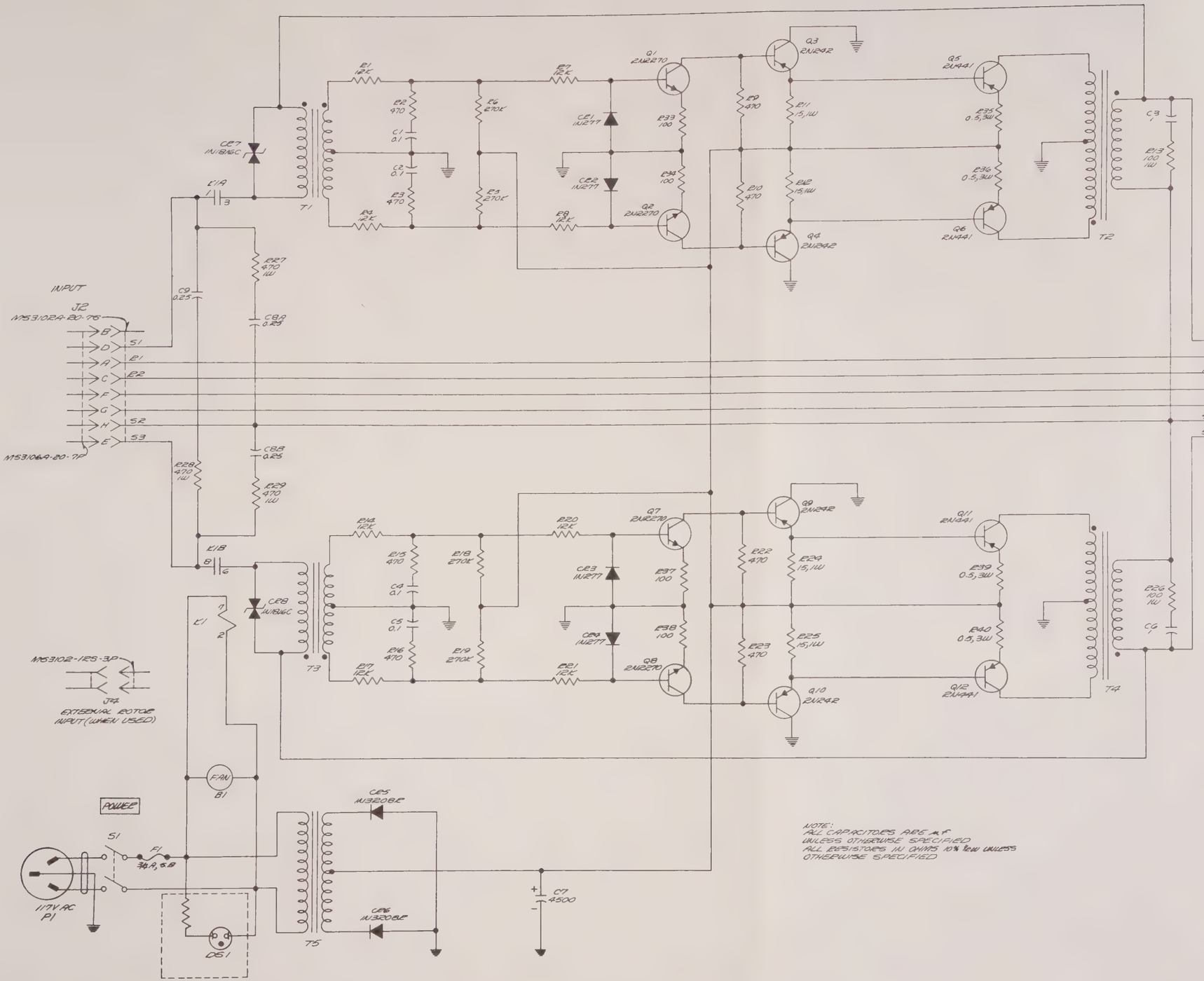
PARTS LIST

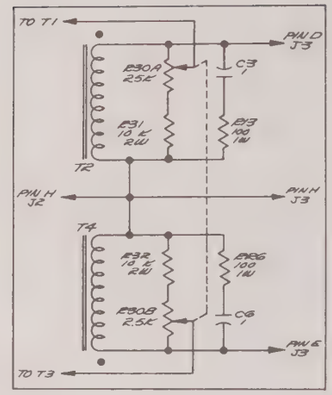
SERIES 4540 SYNCHRO ISOLATION AMPLIFIER - continued

Component Designation	Description	Mfr.*	Mfr. Part No.
R24 R25	See R11		
R26	See R13		
R27 R28 R29	Resistor, fixed, composition, 470 ohms ±10%, 1w	O	LD
R30A/B**	Resistor, variable, composition, dual 2500 ohms, 2w	O	CCLU-2521
R31** R32**	Resistor, fixed, composition, 10,000 ohms ±10%, 2w	O	LD
R33 R34 R37 R38	Resistor, fixed, composition, 100 ohms ±10%, 1/2w	O	LD
R35 R36 R39 R40	Resistor, fixed, composition 0.5 ohm ±10%, 1/2w	O	LD
R37 R38	See R33		
R39 R40	See R35		
S1	Switch, toggle, DPST	CH	7561K4
T1 T3	Transformer, interstage, 10,000-ohm pri; 90,000-ohm CT sec.	TT	A31-X
T2 T4	Transformer, filament, 115v pri; 12.6v CT, 2.5a sec.	TT	F26-X
T3	See T1		
T4	See T2		
T5	Transformer, filament, 115v pri; 25.2v CT, 2a sec.	TT	F41-X
XDS1	Pilot lamp assembly, red cap, with internal 56k, 1/3-watt resistor	DI	521308-991
XF 1	Fuseholder, panel mounting	BUS	HKP
XK 1	Socket, octal	CM	8AM

*See "MANUFACTURERS' CODE LETTERS."

**Model 4542 Only.





OUTPUT CIRCUIT OF MODEL 4542

Series 4540 Synchro Isolation Amplifier
Schematic Diagram

CONVERSION OF VOLTAGE AND POWER RATIOS TO DECIBELS

The basic chart below indicates the number of decibels (dB) corresponding to the listed ratios of voltage or power over the range of −20 to +20 dB. For voltage or power ratios greater than those included in the chart, the ratio can be broken down into a product of two numbers, the value in dB for each found separately, and the two results added. Example: To convert a power ratio of 2,000:1 to dB, express 2,000 as 2×10^3; the number of dB corresponding to a power ratio of 2 is very nearly 3, and the number of dB for a power ratio of 10^3 is 30. Therefore, the power ratio of 2,000:1 is approximately 30 dB + 3 dB = 33 dB. In the lower righthand corner of the chart dB values for voltage and power ratios of integral powers of 10 are given.

Voltage Ratio	*Power Ratio*	*−dB+*	*Voltage Ratio*	*Power Ratio*	*Voltage Ratio*	*Power Ratio*	*−dB+*	*Voltage Ratio*	*Power Ratio*	*Voltage Ratio*	*Power Ratio*	*−dB+*	*Voltage Ratio*	*Power Ratio*
1.000	**1.000**	**0**	**1.000**	**1.000**	**.447**	**.200**	**7.0**	**2.239**	**5.012**	**.200**	**.0398**	**14.0**	**5.012**	**25.12**
.989	.977	.1	1.012	1.023	.442	.195	7.1	2.265	5.129	.197	.0389	14.1	5.070	25.70
.977	.955	.2	1.023	1.047	.437	.191	7.2	2.291	5.248	.195	.0380	14.2	5.129	26.30
.966	.933	.3	1.035	1.072	.432	.186	7.3	2.317	5.370	.193	.0372	14.3	5.188	26.92
.955	.912	.4	1.047	1.096	.427	.182	7.4	2.344	5.495	.191	.0363	14.4	5.248	27.54
.944	.891	.5	1.059	1.122	.422	.178	7.5	2.371	5.623	.188	.0355	14.5	5.309	28.18
.933	.871	.6	1.072	1.148	.417	.174	7.6	2.399	5.754	.186	.0347	14.6	5.370	28.84
.923	.851	.7	1.084	1.175	.412	.170	7.7	2.427	5.888	.184	.0339	14.7	5.433	29.51
.912	.832	.8	1.096	1.202	.407	.166	7.8	2.455	6.026	.182	.0331	14.8	5.495	30.20
.902	.813	.9	1.109	1.230	.403	.162	7.9	2.483	6.166	.180	.0324	14.9	5.559	30.90
.891	**.794**	**1.0**	**1.122**	**1.259**	**.398**	**.159**	**8.0**	**2.512**	**6.310**	**.178**	**.0316**	**15.0**	**5.623**	**31.62**
.881	.776	1.1	1.135	1.288	.394	.155	8.1	2.541	6.457	.176	.0309	15.1	5.689	32.36
.871	.759	1.2	1.148	1.318	.389	.151	8.2	2.570	6.607	.174	.0302	15.2	5.754	33.11
.861	.741	1.3	1.161	1.349	.385	.148	8.3	2.600	6.761	.172	.0295	15.3	5.821	33.88
.851	.724	1.4	1.175	1.380	.380	.145	8.4	2.630	6.918	.170	.0288	15.4	5.888	34.67
.841	.708	1.5	1.189	1.413	.376	.141	8.5	2.661	7.079	.168	.0282	15.5	5.957	35.48
.832	.692	1.6	1.202	1.445	.372	.138	8.6	2.692	7.244	.166	.0275	15.6	6.026	36.31
.822	.676	1.7	1.216	1.479	.367	.135	8.7	2.723	7.413	.164	.0269	15.7	6.095	37.15
.813	.661	1.8	1.230	1.514	.363	.132	8.8	2.754	7.586	.162	.0263	15.8	6.166	38.02
.804	.646	1.9	1.245	1.549	.359	.129	8.9	2.786	7.762	.160	.0257	15.9	6.237	38.90
.794	**.631**	**2.0**	**1.259**	**1.585**	**.355**	**.126**	**9.0**	**2.818**	**7.943**	**.159**	**.0251**	**16.0**	**6.310**	**39.81**
.785	.617	2.1	1.274	1.622	.351	.123	9.1	2.851	8.128	.157	.0246	16.1	6.383	40.74
.776	.603	2.2	1.288	1.660	.347	.120	9.2	2.884	8.318	.155	.0240	16.2	6.457	41.69
.767	.589	2.3	1.303	1.698	.343	.118	9.3	2.917	8.511	.153	.0234	16.3	6.531	42.66
.759	.575	2.4	1.318	1.738	.339	.115	9.4	2.951	8.710	.151	.0229	16.4	6.607	43.65
.750	.562	2.5	1.334	1.778	.335	.112	9.5	2.985	8.913	.150	.0224	16.5	6.683	44.67
.741	.550	2.6	1.349	1.820	.331	.110	9.6	3.020	9.120	.148	.0219	16.6	6.761	45.71
.733	.537	2.7	1.365	1.862	.327	.107	9.7	3.055	9.333	.146	.0214	16.7	6.839	46.77
.724	.525	2.8	1.380	1.905	.324	.105	9.8	3.090	9.550	.145	.0209	16.8	6.918	47.86
.716	.513	2.9	1.396	1.950	.320	.102	9.9	3.126	9.772	.143	.0204	16.9	6.998	48.98
.708	**.501**	**3.0**	**1.413**	**1.995**	**.316**	**.100**	**10.0**	**3.162**	**10.000**	**.141**	**.0200**	**17.0**	**7.079**	**50.12**
.700	.490	3.1	1.429	2.042	.313	.0977	10.1	3.199	10.23	.140	.0195	17.1	7.161	51.29
.692	.479	3.2	1.445	2.089	.309	.0955	10.2	3.236	10.47	.138	.0191	17.2	7.244	52.48
.684	.468	3.3	1.462	2.138	.306	.0933	10.3	3.273	10.72	.137	.0186	17.3	7.328	53.70
.676	.457	3.4	1.479	2.188	.302	.0912	10.4	3.311	10.96	.135	.0182	17.4	7.413	54.95
.668	.447	3.5	1.496	2.239	.299	.0891	10.5	3.350	11.22	.133	.0178	17.5	7.499	56.23
.661	.437	3.6	1.514	2.291	.295	.0871	10.6	3.388	11.48	.132	.0174	17.6	7.586	57.54
.653	.427	3.7	1.531	2.344	.292	.0851	10.7	3.428	11.75	.130	.0170	17.7	7.674	58.88
.646	.417	3.8	1.549	2.399	.288	.0832	10.8	3.467	12.02	.129	.0166	17.8	7.762	60.26
.638	.407	3.9	1.567	2.455	.285	.0813	10.9	3.508	12.30	.127	.0162	17.9	7.852	61.66
.631	**.398**	**4.0**	**1.585**	**2.512**	**.282**	**.0794**	**11.0**	**3.548**	**12.59**	**.126**	**.0159**	**18.0**	**7.943**	**63.10**
.624	.389	4.1	1.603	2.570	.279	.0776	11.1	3.589	12.88	.125	.0155	18.1	8.035	64.57
.617	.380	4.2	1.622	2.630	.275	.0759	11.2	3.631	13.18	.123	.0151	18.2	8.128	66.07
.610	.372	4.3	1.641	2.692	.272	.0741	11.3	3.673	13.49	.122	.0148	18.3	8.222	67.61
.603	.363	4.4	1.660	2.754	.269	.0724	11.4	3.715	13.80	.120	.0145	18.4	8.318	69.18
.596	.355	4.5	1.679	2.818	.266	.0708	11.5	3.758	14.13	.119	.0141	18.5	8.414	70.79
.589	.347	4.6	1.698	2.884	.263	.0692	11.6	3.802	14.45	.118	.0138	18.6	8.511	72.44
.582	.339	4.7	1.718	2.951	.260	.0676	11.7	3.846	14.79	.116	.0135	18.7	8.610	74.13
.575	.331	4.8	1.738	3.020	.257	.0661	11.8	3.890	15.14	.115	.0132	18.8	8.710	75.86
.569	.324	4.9	1.758	3.090	.254	.0646	11.9	3.936	15.49	.114	.0129	18.9	8.811	77.62
.562	**.316**	**5.0**	**1.778**	**3.162**	**.251**	**.0631**	**12.0**	**3.981**	**15.85**	**.112**	**.0126**	**19.0**	**8.913**	**79.43**
.556	.309	5.1	1.799	3.236	.248	.0617	12.1	4.027	16.22	.111	.0123	19.1	9.016	81.28
.550	.302	5.2	1.820	3.311	.246	.0603	12.2	4.074	16.60	.110	.0120	19.2	9.120	83.18
.543	.295	5.3	1.841	3.388	.243	.0589	12.3	4.121	16.98	.108	.0118	19.3	9.226	85.11
.537	.288	5.4	1.862	3.467	.240	.0575	12.4	4.169	17.38	.107	.0115	19.4	9.333	87.10
.531	.282	5.5	1.884	3.548	.237	.0562	12.5	4.217	17.78	.106	.0112	19.5	9.441	89.13
.525	.275	5.6	1.905	3.631	.234	.0550	12.6	4.266	18.20	.105	.0110	19.6	9.550	91.20
.519	.269	5.7	1.928	3.715	.232	.0537	12.7	4.315	18.62	.104	.0107	19.7	9.661	93.33
.513	.263	5.8	1.950	3.802	.229	.0525	12.8	4.365	19.05	.102	.0105	19.8	9.772	95.50
.507	.257	5.9	1.972	3.890	.227	.0513	12.9	4.416	19.50	.101	.0102	19.9	9.886	97.72
.501	**.251**	**6.0**	**1.995**	**3.981**	**.224**	**.0501**	**13.0**	**4.467**	**19.95**	**.100**	**.0100**	**20.0**	**10.000**	**100.00**
.496	.246	6.1	2.018	4.074	.221	.0490	13.1	4.519	20.42		10^{-3}	30		10^3
.490	.240	6.2	2.042	4.169	.219	.0479	13.2	4.571	20.89	10^{-2}	10^{-4}	40	10^2	10^4
.484	.234	6.3	2.065	4.266	.216	.0468	13.3	4.624	21.38		10^{-5}	50		10^5
.479	.229	6.4	2.089	4.365	.214	.0457	13.4	4.677	21.88	10^{-3}	10^{-6}	60	10^3	10^6
.473	.224	6.5	2.113	4.467	.211	.0447	13.5	4.732	22.39		10^{-7}	70		10^7
.468	.219	6.6	2.138	4.571	.209	.0437	13.6	4.786	22.91	10^{-4}	10^{-8}	80	10^4	10^8
.462	.214	6.7	2.163	4.677	.207	.0427	13.7	4.842	23.44		10^{-9}	90		10^9
.457	.209	6.8	2.188	4.786	.204	.0417	13.8	4.898	23.99	10^{-5}	10^{-10}	100	10^5	10^{10}
.452	.204	6.9	2.213	4.898	.202	.0407	13.9	4.955	24.55		10^{-11}	110		10^{11}
										10^{-6}	10^{-12}	120	10^6	10^{12}

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